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Searching for Answers: Networks of Practice Among Public Administrators

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Abstract

How do public administrators find information about the problems they confront at work? In particular, how and when do they reach across organizational boundaries to find answers? There are substantial potential obstacles to such searches for answers, especially in a system of decentralized governance such as the U.S. government. In this article, we examine the alternative mechanisms within the public sector that compensate for this dispersion of expertise, focusing on knowledge sharing across public DNA forensics laboratories. In particular, we propose that the emergence of informal interpersonal networks plays an important role in providing access to necessary expertise within a highly decentralized system. Our findings point both to the need for further research on knowledge sharing networks within the public sector as well as practical implications around the value of investments into facilitating the creation and maintenance of networks of practice.

Keywords

cross-jurisdictional knowledge sharing, diffusion, innovation, network of practice, case study

Introduction

How does a lesson learned in one agency, one state government, one locale, provide insights that others might borrow? Although innovation has been articulated as one of the major advantages of a decentralized system, the very dispersion of government in a federal system creates enormous obstacles to lesson sharing. We propose that in some domains there exist emergent *networks of practice*, where administrators connect to each other in a search for reliable answers to questions that arise on their job, and whose structure transcends organizational boundaries, prescribed reporting structures, and jurisdictions.

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This insight builds on a recent surge of research on the role that networks play in the capacity of public organizations (Agranoff, 2006; McGuire, 2002; Milward & Provan, 2000; O'Toole & Meier, 2004; Provan, Huang, & Milward, 2009; Weber & Khademian, 2008). Little of this research, however, examines knowledge interdependences in informal public sector networks. This is a striking contrast to the literature on private organizations, which has examined knowledge sharing within and across firms (Podolny & Page, 1998; Powell, Koput, & Smith-Doerr, 1996; Uzzi, 1997). This article contributes to the existing literature on public sector networks by examining whether and how informal interpersonal networks emerge as a result of local needs for knowledge, and how public managers use their informal networks to overcome complex problems.

In an in-depth interpretive case study, we examine a particular population of geographically dispersed government organizations—government crime laboratories involved in DNA analysis. The use of DNA in the criminal justice system has grown exponentially in the last decade, and this growth, combined with the rapidly changing technology, has created particular stresses on decision makers within the approximately 180 government labs scattered across the country, many with just a handful of DNA analysts. This domain thus offers an "easy case" to detect the possible presence of networks of practice—that is, relationships formed around a set of focal practices.

We find that there is indeed a robust network of practice in this domain. However, this network exists symbiotically with the hierarchical structures in the system, where many of the control mechanisms of the system, such as inspections and FBI-sponsored training, catalyze peer-to-peer knowledge sharing. Furthermore, although we find that this network is critical to the effectiveness of particular labs, some of the emergent features of the network are traditionally associated with hierarchies, including the centralization around particular knowledge hubs, and the development of silos based on state boundaries.

Below, we first develop a synthesis of the varied literatures on networks in public administration and the knowledge-based view of organizations. We then discuss the particular domain of our research—forensic DNA labs in the United States, outlining our methodology to study how public managers actively seek knowledge in a decentralized system of government. We then provide our findings, concluding with a discussion about the implications both for scholarship and practice.

Public Sector Networks and Cross-Jurisdictional Knowledge Diffusion

The role of interorganizational public networks has received significant attention in recent years, and the idea that there are networks that support interjurisdictional diffusion dates back at least to Walker (1969). Below, we discuss these distinct literatures, and then turn to an emerging literature on the management of knowledge in public sector organizations. Our aim is to bridge these distinctive research traditions, and extend extant literature to include the role of informal knowledge sharing networks in the public sector.

Networks in the Public Sector

Although there is a growing body of literature on public sector networks (e.g., Agranoff, 2006; Agranoff & McGuire, 2001; Bardach, 1999, 2001; McGuire, 2002; Meier & O'Toole, 2001; Milward & Provan, 2000; O'Toole & Meier, 2004; Provan et al., 2009; Weber & Khademian, 2008), this literature mainly focuses on process interdependence, or analyzing coordination networks among various agencies. For example, how do agencies need to coordinate effectively to deliver public services within a formalized, for example, contractual, network? Networks in the public sector are generally regarded as a governance mechanism that serves to solve so-called *wicked problems*, or *problems of the hollow state* (Rittel & Webber, 1973). Milward and Provan define the hollow state

as a "metaphor for the increasing list of third parties, often non-profits, to deliver social services and generally act in the name of the state" (Milward & Provan, 2000, p. 359). Most of the empirical research in this domain has examined the joint production of public services (such as contracting, or principal-agent relationships) within collaborative networks (e.g., Agranoff & McGuire, 2001; Mandell, 2001; Nelson, Bloomfield, Hales, & Libby, 2001; O'Toole, 1997).

In short, the existing public administration literature has focused mainly on collaborative problem solving in intergovernmental, intersectoral (Agranoff, 1996; Ansell & Gash, 2008), and formally established ties (cf. Provan, Isett, & Milward, 2004) to ensure network effectiveness. In contrast to the robust thread of research on formal networks that has emerged over the last decade, there is relatively little research on how *informal networks* support task execution across agencies in the public sector. In fact, little analytic attention has been paid to the distinction between formal and informal networks in the existing public administration literature (Isett, Mergel, LeRoux, Mischen, & Rethemeyer, 2011). We define *formal* network ties as those relationships that are established through hierarchical positions, reporting structures, and official duties and competences within and across organizations (Blau, 1963). In short, formal ties are role prescribed. For example, formal ties exist between a supervisor and her subordinate, or between two government agencies with a memorandum of understanding to temporarily collaborate on a project.

We define *informal* ties as interpersonal relationships that are extra role (Mergel, Lazer, & Binz-Scharf, 2008). These relationships can cut across traditional organizational structures (such as functions and divisions) and therefore generally are not included in formal reporting procedures (e.g., Krackhardt & Hanson, 1993), which makes them more elusive and difficult to document. Thus, for example, one might distinguish formal pathways to mobilize support in an organization (call IT support for assistance with a computer) from informal ones (ask the individual in the neighboring office if they know how to solve the problem). The management literature is replete with examples of the essential role informal networks play within and across organizations, for example, as a vehicle to speed up knowledge exchange, increase the efficiency of work, and foster accidental communication about work-related topics, which adds to and interplays with the formal communication and reporting structure (Cummings, 2004; Hansen, 1999, 2002; Knoke & Burt, 1983; Krackhardt & Stern, 1988; Tichy & Fombrun, 1979).

Cross-Jurisdictional Diffusion of Knowledge

There is a significant literature on interstate diffusion of knowledge, following from Walker (1969). However, most of this research addresses the legislative level (e.g., Soss, Schram, Vartanian, & O'Brien, 2001; Volden, 2006). Our study focuses on the microscopic decisions that happen at the street level (or, more appropriately given our case, the bench level). How are the individual decisions made by public employees directly dependent on the information and insights they get from others outside of their immediate organization?

An important research stream that informs our study is the literature on the diffusion of innovation, some of which looks at diffusion among public sector organizations (cf. Rogers, 1995). There is a direct linkage between our argument with respect to "searching" for answers and the diffusion literature, because the spread of information that is novel to the recipient might be viewed as innovative from the recipient's point of view. In our study, we look at knowledge diffusion from a different angle and focus on the individual knowledge-sourcing strategies (Gray & Meister, 2004). In other words, we describe innovation as "search, when you don't know what you are looking for" (Girard & Stark, 2007). There is an active component to diffusion when applied to the decisions of public administrators: Innovative knowledge is not passively transported through the social system, but actively sought for based on individual choices. This qualitative viewpoint of the procedural microlevel decision includes the individual's choice of source and the reason for the selection of

the chosen specific source. Researchers, such as Nebus (2006), have suggested the use of individual choice models in theories of social structure (Coleman & Fararo, 1992; Lindenberg, 1985, 1990). Much of this research is grounded in the organizational behavior literature, to which we now turn.

Networks of Practice

In the knowledge-based view of the organization (Grant, 1996), knowledge is viewed as a scarce resource, and its creation and use is what determines the competitive advantage of an organization.[1] To be useful to someone other than its creator(s), knowledge needs to be shared. The sharing of knowledge is relatively easy when the knowledge to be shared is explicit, that is, verbalized, written, drawn, or otherwise articulated (Nonaka, 1994). A classical example in bureaucracies is given by "the files" (Weber, 1921/1968), today joined by large databases. Tacit (or implicit) knowledge, however, is more difficult to share: Polanyi (1966) asserted that individuals know more than they can explain; that is, individuals have knowledge that is nonverbalized, intuitive, and unarticulated. Tacit knowledge has been defined as hard to communicate, deeply rooted in action, involvement, and commitment within a specific context (Polanyi, 1962); "a continuous activity of knowing" (Nonaka, 1994, p. 16); or, more practically, as "the way things are done around here" (Spender, 1996). Furthermore, as tacit knowledge is not articulated (and thus likely resides in an individual's brain), its transfer requires the interaction between individuals, whereas explicit knowledge can be retrieved from nonhuman sources such as reference databases (Schreiber & Carley, 2003). Similarly, although computer-mediated communication has been found to facilitate knowledge transfer (e.g., Constant, Sproull, & Kiesler, 1996; Kiesler & Sproull, 1992; Sproull & Kiesler, 1986), technology cannot substitute for face to face interaction (e.g., Hinds & Bailey, 2003).

Not all knowledge required to pursue an organization's goals is readily available within the organizational boundaries (Anand, Glick, & Manz, 2002; Grant, 1996; Spender & Grant, 1996). Therefore, members of an organization often rely on knowledge from external third parties (Anand et al., 2002). Research shows that professionals rely on their communities of peers when it comes to specialized knowledge (Cross, Parker, Prusak, & Borgatti, 2001; Orlikowski, 2002), and among those, they turn to those individuals they trust, are friends with or whom they respect (Ibarra & Andrews, 1993; Krackhardt & Kilduff, 1999). Within the organizational literature, the idea that there exist knowledge-based "communities of practice" has gained substantial currency. Communities of practice are bounded groupings of professionals who engage in similar practices and have frequent occasions to interact with each other (Lave & Wenger, 1991; Wenger, 1998). They learn from one another through a process termed *legitimate peripheral participation* (Lave & Wenger, 1991), where, much like in an apprenticeship, individuals who are new to the practice only engage in it peripherally before acquiring in-depth knowledge from more experienced individuals, which over time permits them to fully adopt the practice.[2]

A related but broader concept is that of *networks of practice*, which can be defined as a set of loosely coupled relationships between individuals who are not necessarily collocated but engage in practices that share a certain degree of similarity (Vaast & Walsham, 2009). Although members of a network of practice may never have met face to face, or not even be aware of each other, they share common practices and tend to have an interest in similar issues (Brown & Duguid, 2001; Vaast & Walsham, 2009). A network of practice is generally more open than a community of practice and the relationships among its members are looser—they share an overall knowledge domain, but the redundancies in what they know and do are not as strong (Vaast & Walsham, 2009). We refer to the system that is the subject of our study as a network of practice because it fits the above description of such a network well: DNA forensic scientists working in government crime labs scattered across the country are mostly aware of each other, but they may never have met face to face. They follow the same federal rules and regulations, but develop practices that are molded by their local context and may therefore be partly similar or different (Vaast & Walsham, 2009).

However, regardless of their organizational affiliation, they share a significant degree of similarity in their practices and could benefit from communicating with each other and exchanging ideas about their practices (Duguid, 2005).

It is important to notice that most of the research on communities and networks of practice has been conducted in private sector settings (a notable exception is Eglene et al.'s (2007) study on public sector knowledge networks). Knowledge sharing in the public sector meets some specific challenges, such as tighter budget restrictions than in the private sector; data privacy and confidentiality, and related security issues, which, due to mandatory regulations, are a top priority for government; as well as traditionally rigid hierarchical structures and organizational boundaries that stand in stark contrast to the informal structure of knowledge networks (Bardach, 1999; Binz-Scharf, 2008; Fountain, 2001). However, "networks and bureaucracy coexist and interact" in this setting (Eglene et al., 2007, p. 92, citing O'Toole, 1997): Innovation happens through informal, mostly horizontal, collaboration, whereas formal, vertical, authority remains important in the bureaucratic government environment (Eglene et al., 2007). Moreover, recent collaborative governance literature suggests that as mandates broaden in scope, public sector actors need to reach across organizational boundaries and include the knowledge and resources of third parties into their own practices (O'Leary & Bingham, 2009).

Research Design

This article examines knowledge sharing among individuals in multiple public organizations that are all part of a highly controlled system. These individuals are specialized professionals who each operate within the reporting structure of the organization they are affiliated with. However, at the same time, they need to follow the procedural rules and regulations issued by the controlling federal agency, which sometimes supersede local procedures. The reason for this configuration is a constitutionally mandated dispersion of authority to state governments, and within those, a pressure to create geographic equity by further dispersing authority to local governments. This geographic dispersion is not related to a clear separation in the types of issues encountered and the knowledge required to deal with them. Therefore, the tasks executed and the problems encountered by these professionals are mostly similar across different organizations. The solutions to problems, however, vary significantly, as they are the fruit of individual interpretations, based on various constellations of institutional resources, culture, and other countless characteristics. Our key objective was to understand how knowledge is actively sought by individuals within this decentralized system. Specifically, our study posed the following research questions:

Research Question 1: What search strategies do individuals adopt when looking for information? That is, where and how do people look for answers?
Research Question 2: What factors determine these individual search strategies?

We addressed these questions with an interpretive case study, aiming at generating theory that emerges from the knowledge-sharing activities occurring in the empirical setting under inquiry (Emerson, Fretz, & Shaw, 1995). We followed Miles and Huberman's (1994) conceptual approach to the design, collection, and analysis of qualitative data. In this approach, the researcher starts out by distilling ideas into initial categories, which are used to create a conceptual framework. This framework then serves as a basis for data collection and analysis. In our study, the initial focus was on the need for public administrators to reach outside of their organization to acquire the knowledge necessary to accomplish essential tasks.

This focus was developed on the basis of the second author's intimate knowledge of the DNA forensics community, the first author's preliminary observations of and interactions with this community, as well as extant organizational and networks literature. These initial observations suggested

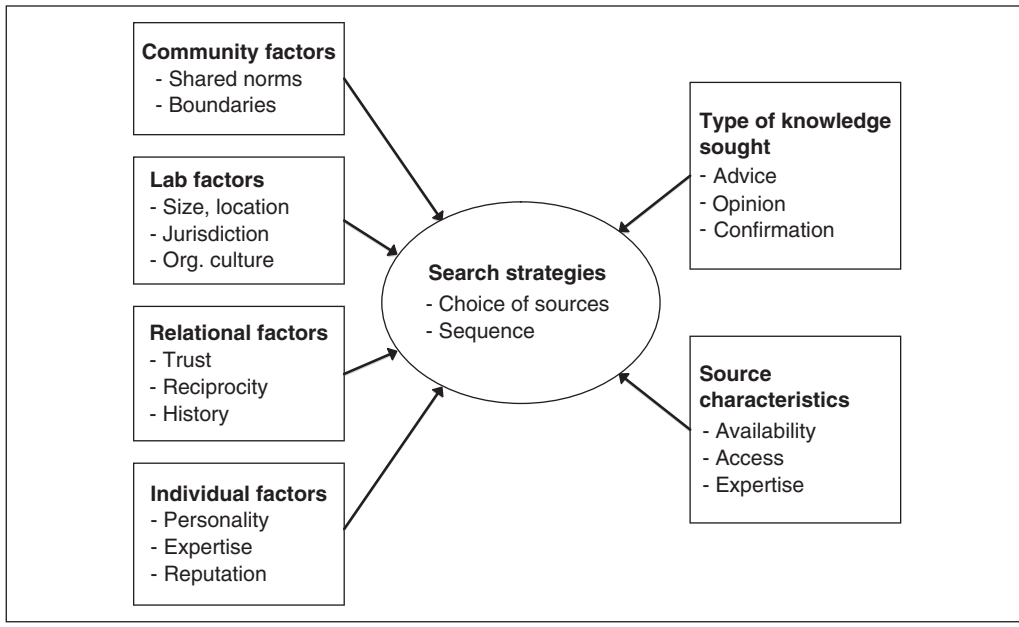

Figure 1. Conceptual framework

that there existed an epistemic network of knowledge sharing, and that while the central authority in the system (the FBI) did indeed play a pivotal role, that it did not mediate most knowledge transfer among laboratories. Even brief exposure to the system indicated, unsurprisingly, that it has a distinctive and varied cast of characters that have settled into distinctive roles in the system; and that laboratories and regions have converged on sometimes different norms and practices.

The categories that emerged were centered around factors that influence an individual's choice among various knowledge sources. Figure 1 presents our initial conceptual framework of search strategies and their determinants. According to this framework, an individual's search behavior is contextualized by "exogenous" factors at the community level, such as the perception of the community's boundaries, and shared norms within the community. At the organization level, the size, jurisdiction, and location of the organization (and, related to the latter, the proximity to other organizations doing similar work) might have an influence on an individual's search strategies, as does the lab's organizational culture. For example, strictly observed reporting structures might discourage an individual from "shopping" for an answer instead of going to her supervisor. However, individual characteristics play into such a decision as well: Personality, expertise, seniority, and reputational concerns, among others, likely determine one's strategies for searching for answers. Finally, the choice of sources, as well as the sequence in which one might approach these, can be expected to differ according to the type of knowledge sought (e.g., advice, opinion, confirmation, and whether it is tacit or explicit) and the source characteristics, such as access to and availability of a certain source.

Nevertheless, the framework, although providing some initial structure, does not control the analysis. It is prone to modification as the data collection and analysis unfold, and its final structure might differ significantly from what it looked like at the outset. Therefore, the analysis is data driven, aiming at understanding the viewpoints of the individuals who participate in the study.

It is important to note at this point that the theoretical concepts we present here emerged from our study, and are thus a result of our data interpretation, rather than a starting point for data collection

and analysis. This is a distinct characteristic of grounded, interpretive research, where the theoretical concepts and framework are grounded in, and emerge from, the data, instead of being drawn from prior theory to guide the collection and analysis of data (Suddaby, 2006). In this research paradigm, it is common to report data and their interpretation before the theoretical concepts are introduced (Suddaby, 2006, p. 637, citing Dact, 1985). We have chosen, however, to follow a more traditional presentation strategy and to introduce the theoretical concepts before we turn to data reporting and interpretation, in the hope that doing so will clarify in advance our argument and theoretical contributions, while keeping in mind that these concepts actually emerged from the study itself in a process of going back and forth between data and relevant literature (Strauss, 1987; Suddaby, 2006).

Field Setting

Given that this is an exploratory study aiming at illuminating the presence and dynamics of knowledge-sharing processes within a dispersed policy community, we selected our setting in such a way that we could expect with a relatively high degree of certainty to be able to observe and analyze the phenomenon of interest here. The case we have chosen is that of the professionals in government crime laboratories involved in the forensic DNA analysis. The work of forensic scientists is knowledge intensive, specialized, and highly complex, and it is subject to constantly changing technology (Bieber, 2004). The minimum educational requirement to be a forensic scientist[3] is a bachelor of science degree, most commonly in chemistry or biology. Many DNA analysts also have a master of science degree (often mandatory for supervisory positions) in chemistry, biology, or forensic science, and several among them have a PhD in these or related disciplines. The profession has experienced an enormous rise in popularity, thanks to the television series "CSI", a phenomenon insiders refer to as the "CSI effect" (Willing, 2004).

There are DNA laboratories at the federal, state, and local levels. These labs are generally nonhierarchically arranged—that is, state labs generally do not have authority over local labs, nor do federal over state labs. However, there are elements of hierarchy within the system, with respect to the following: (a) the infrastructure (where, for example, the FBI sets the rules regarding access to the national database, as discussed below); (b) resources (e.g., the federal government provides significant resources to state and local laboratories); and (c) federal regulation (which is in part based on FBI requirements, following from point "a").

Neither the size of a single lab nor the number of labs in a given state necessarily reflect the size (or population) of the state they reside in. Rather, the configuration is a result of historical development, in part due to state and local jurisdictions that attribute more or less importance to DNA analysis (which is reflected in the budget given to labs), institutional entrepreneurship (a successful lab is more likely to expand), and geographical necessity (a large state might feel the functional or political need for dispersed laboratory capacity).

Federal law enables states to upload certain DNA profiles into a database system called the Combined DNA Index System (CODIS), managed by the FBI. The database contains the DNA profiles of qualified offenders (in most states, convicted felons) and profiles from crime scenes. The objective of the database is to link known individuals to crimes as well as crimes to each other.[4] The state component of the database is known as the State DNA Index System (SDIS), where a subset of these profiles is also uploaded into the National DNA Index System (NDIS).[5] The FBI distinguishes between DNA testing labs and DNA databasing labs, that is, some local labs do not directly upload their profiles into the CODIS system, but send them to another lab in the same state that does databasing.

Although procedural rules and regulations vary between labs and across jurisdictions, the core work of forensic scientists in government crime labs is essentially the same. It comprises tasks such as determining the usefulness of a DNA sample provided by crime scene investigators, the

preparation of a sample for analysis, the interpretation of DNA mixtures (e.g., when the DNA of two or more individuals is present in a sample), creating DNA profiles, and uploading the DNA profiles of convicted offenders into a database. The vast majority of procedures involved in these tasks is described in painstaking detail in the labs' manuals, which are constantly updated to reflect the rapid change of technology and the resulting new procedures. Furthermore, the FBI issues regulations that govern access to CODIS. Lab procedures are regularly audited under the auspices of the FBI, and need to conform to standards set by the National Institute for Standards and Technology (NIST). Despite this high level of codification, there remains a considerable amount of uncertainty in the work of DNA forensic scientists. For example, as we mentioned above, the processing of DNA mixtures requires interpretation. There are a number of statistics that can be used in this case, and in fact, different labs prescribe the use of different statistics (Butler, 2005). Another example regards the adoption of newly available technologies. Apart from the decision on the technology per se, there is a host of private vendors to choose from, and the quality of the purchased material as well as the available support from vendors can significantly influence both the efficiency and efficacy of a lab. Finally, there is a wide array of discretionary management issues, ranging from human resource issues to decisions around the design of new laboratory space. Dealing with these uncertainties often requires coming up with creative solutions, which result in the adaptation of preexisting procedures and constitute a form of innovation (Woodman, Sawyer, & Griffin, 1993).

DNA laboratories in the United States, as a population, offer a good substrate within which to study knowledge sharing within government. There is a discrete population of laboratories (about 180), with at least one laboratory in every state. In this undeniably dynamic knowledge-intensive domain, there is substantial discretion at the laboratory level. They present a "petri dish" within which to study the possibilities of knowledge sharing within a decentralized system of government.

Data Collection

Our goal was to compile a comprehensive sample of individuals with the most common professional roles, reflecting behavior across different types and sizes of labs, to understand the entire system under inquiry. Respondents for this study were selected through purposeful sampling (Yin, 1994) according to the professional roles held by members of the community in a single case study design with multiple sites. This method of sampling allows for comparability between the respondents and at the same time incorporates the range of different realities that characterize the various government DNA labs. We initially focused our recruitment efforts on state CODIS administrators, because we assumed that these individuals had greater needs to connect to their peers in other labs, as there is only one CODIS administrator per lab. After a first round of telephone interviews, two of the authors attended several CODIS conferences and interviewed state administrators in person. Attending these conferences allowed these authors to gain insight into the interaction patterns among CODIS administrators. Early participants in the study led us sequentially to additional important respondents within the community (Miles & Huberman, 1994). In particular, it soon became clear that it would be beneficial to extend the sample to other professional roles as well as to individuals in local labs. We therefore sought to be introduced to such individuals through our initial respondents. We stopped recruiting additional respondents when we started getting very similar responses and therefore had reached saturation in our sample. Our final pool of respondents consisted of 33 individuals, from 30 labs and 26 states.

The roles in our final sample were those of CODIS administrator, technical manager, and lab director. The CODIS administrator is the individual in a databasing lab who is the gatekeeper for the CODIS database and determines what goes into NDIS, if she is a state administrator. The

Table 1. Overview of Interviews Conducted

Professional role[a]	Affiliation: State lab	Affiliation: Local lab	Total
Lab director	8	2	10
Technical leader	7	3	10
CODIS administrator	8	5	13
Total	23	10	33

a. In cases where individuals hold multiple roles, the highest-ranking role is indicated.

technical manager is in charge of the actual laboratory work. Thus, the technical manager oversees the development of procedures, and the distribution of tasks. Whereas the positions of CODIS administrator and technical manager are generally held by different individuals in large labs, in smaller labs it is common for one individual to wear multiple hats; that is, the CODIS administrator and the technical manager can be the same person. Similarly, the range of roles a lab director holds varies significantly with the size of the lab. The lab director generally has the greatest exposure in terms of contacts outside the lab.[6] An overview of respondents' professional roles and their affiliations is presented in Table 1.

We conducted semistructured, open-ended interviews with these individuals, lasting between 30 minutes and two hours each. The interviews covered the following topics:

Description of work function and work environment: The hierarchical relationships the respondent is embedded in and the proximity to peers within the lab;
Description of knowledge required for the job: The areas of expertise and the types of knowledge the interviewee required, such as technical or legal knowledge, advice, or opinions;
Habitual knowledge sources: The most commonly used knowledge sources for the identified types of required knowledge, media and venues used, and difficulties in retrieving knowledge from these specific sources;
Engagement in the community: The behavior of interviewees when approached with a question, in particular regarding their motivation to set aside time to answer questions from colleagues and peers, the content of questions, and reasons for answering certain questions rather than others.

As our data collection proceeded, we also included specific questions about the nature of ties to individuals in other labs.

In addition to the abovementioned data collection efforts, two of the authors visited several crime labs and observed forensic scientists at their workplace. Although these were not full-fledged ethnographies, the observers were nonetheless able to get a sense of the localized settings and work practices in these labs (Emerson et al., 2001), which proved of utmost importance to understanding the work of forensic scientists as described and done by themselves as well as the situational variations between laboratories.

Data Analysis

The analytic process was driven by the objective of making sense of the data by identifying recurring patterns. To this end, we followed the coding and analysis process described in Miles and Huberman (1994). All interviews were transcribed verbatim, and coded in a three-step process. During the first step, which Miles and Huberman refer to as open coding, each author carefully reviewed the interview transcripts as they became available and attributed labels (or codes) to

meaningful passages. The authors then met as a team and discussed each label, resulting in a provisional start list of codes. This list of codes was subsequently used by a team of research assistants to code all interviews with the help of the qualitative research software package NVIVO (2006). The research assistants were instructed to code line by line, that is, the smallest coding unit was to be one line of text. Each member of the research team also wrote memos, or short, reflective remarks about codes and their relationships, which became part of the data. One author periodically met with the team of research assistants and discussed issues that arose during individual coding. Once the initial coding was completed, a senior research assistant ran a coding comparison to ensure intercoder reliability. The level of intercoder reliability was 85%, which is considered acceptable (Smith, Feld, & Franz, 1992).[7] Any discrepancies between the individual coders were discussed until an agreement was reached.

In the next step, referred to as axial (or pattern) coding, similar codes were grouped together into a smaller number of meta-codes. For example, we clustered all codes that referred to the way individuals search for knowledge, what sources they turn to, and the rationales behind those choices, into a meta-code titled "search strategies." This second level of coding helps generalize observations and identify "repeatable regularities" (Kaplan, 1964, quoted in Miles and Huberman, 1994, p. 69). In the example above, we were able to compare the search strategies of each respondent and thus better understand emerging patterns of search.

A further step in the analysis was that of constructing matrix displays to study the relationship between meta-codes and select characteristics of the respondents. To continue our previous example, we categorized respondents according to their professional roles, their affiliations, the size and jurisdiction of their labs, their educational background, and their expertise. We then studied how search strategies varied according to these attributes. This allowed us to find confirmation for our initial assumption that scientists in smaller labs reach out to individuals in larger labs in search for answers, as larger labs tend to have more resources and therefore, for example, are more likely to have newer equipment and experience with it. However, the matrix displays helped us generate important insights that were somewhat counterintuitive, such as the observation that individuals who are considered experts in the network are not necessarily affiliated with a large lab, thus moving certain small labs toward the center of the network of practice.

Throughout the data analysis process, we followed a procedure of doubling back and forth between our conceptual framework, the data, and the literature (Strauss, 1987). As an illustration of this procedure, after an initial round of data collection, we discovered that our conceptual framework did not take into account some of the themes that were emerging. We then went back into the literature and searched for confirmation of these themes. For example, early interviews revealed that many participants subscribed to listservers, and the opinions on and use of these listservers varied considerably. We therefore reviewed specific literature on this topic and included it in our analysis of the data. However, the review of this new literature brought about new conceptual and empirical angles that we had not previously considered, and led us to modify the interview guideline to include questions addressing those issues in subsequent fieldwork.

Findings

Searching for answers, it appears, represents a considerable part of the workload in a knowledge-intensive profession such as that of forensic scientists. Although most of the participants in this study took their enormous knowledge-sharing efforts for granted as part of their daily work, the picture that emerged from the individual accounts and our observations was that of a busy advice network across hierarchical and organizational boundaries, often overcoming, but at times yielding

to, classically bureaucratic barriers to knowledge sharing. In what follows, we present our findings, based on our analysis and interpretation of the fieldwork and the literature.

Access to Knowledge Beyond Organizational Boundaries

The first key question is whether interorganizational knowledge sharing networks matter. That is, do participants reach out to individuals in other organizations to find answers to questions that arise on their job? The answer was an unambiguous yes: Accessing knowledge beyond organizational boundaries occurs regularly, and is essential for individual effectiveness. Every single participant referred to instances where talking to individuals outside of their immediate organization provided information that made them more effective. The account of this participant, a CODIS administrator, is typical:

> [F]or an actual DNA data banking type question there is very little literature on it. It is all in people's heads, the information. So most of those issues are handled by calling people because there simply is not much to look for in print, either as a scientific paper or some kind of a text book because no such thing exists on this—that I'm aware of anyway—that is up to date and will give me information about a very specific new problem and so on.

As a CODIS administrator, this person makes decisions, generally speaking, about which DNA profiles get uploaded into the database. The answer to this type of questions (which the participant refers to as a "DNA data banking type question") is not simply a binary one—there are many gray areas in determining what constitutes a legitimate profile. For example, there could be a mixture of DNA samples from a crime scene, yielding an "excess" of alleles (genetic markers) at each locus. The decision regarding whether to upload a profile involves judgments on what constitutes evidence from a crime scene, interpretation of a particular set of analyses, and interpretation of the rules for inclusion in the national database. Although many of these procedures are recorded in a lab's manuals, these manuals are not exhaustive, especially considering the fast pace at which DNA technology is evolving. Hence, CODIS administrators often need to reach out to peers who might have experience with the specific problem the individual is tackling, as this interviewee makes clear:

> The process goes from local manuals, [to] scientific publications, and then [to] peers. And when I say peers, now I'm talking outside of the laboratory. Because if we do not have it in our manuals, how to do something, we have to look outward.

The use of "local manuals" maps perfectly to Weber's (1921/1968) "knowledge of the files" by bureaucrats. This particular quote highlights the efforts in this location to formally capture local knowledge. The existence of local documentation is in part mandated by external regulatory procedures—for example, FBI rules for access to the national database and American Society of Crime Lab Directors (ASCLD) accreditation require extensive documentation.

The use of "scientific journals" highlights that in this domain there are formal epistemic informational resources that exist outside of the formal hierarchy that nonetheless may be authoritative. The fact that it is accepted that there is such authoritative epistemic knowledge creates the potential for interpersonal information exchange. That is, accepting that someone from outside of the organization might have insight into how to do things within one's organization requires accepting that knowledge transcends the local setting (although for the limits on this, see our observations on perceptions of local exceptionalism below).

From our perspective, the more general principle that this subject is illuminating with respect to interpersonal interorganizational networks is that if the information does not exist locally, it is necessary to consult individuals outside of the organization, as this interviewee indicates:

> We're limited on [statistical] knowledge, so we do need to go outside for that. From a casework perspective we'd like to think we've just about seen it all, here. [. . .] We've been working with it for so long that, we'd like to believe that we can troubleshoot things here, with the knowledge base that we have. So I would say it's probably a statistic type issue. Maybe a kinship issue, relatedness. They're talking about searching databases now to find family members, the aspects involved with that. So that's probably just beyond where our comfort level is, and we would ask advice on that.[8]

These data suggest an interplay between standard hierarchical mechanisms for informational search and network mechanisms. In particular, it appears that individuals sequence their search processes following a pattern molded by the bureaucratic context in which they function: First, they resort to the local sources of information within the standard hierarchical structures of the organization, and then they shift to informal, external resources.

Knowledge Distribution Within the Network

Given that there are vastly uneven resources within the system, as well as accidental variations in experience, it is likely that the knowledge will be unevenly distributed, yielding network-wide reservoirs of expertise. Participants systematically referred to particular corners of the system regarding their reputation in particular domains. For example, this individual refers to the expertise of another lab with respect to their recommendations regarding hardware:

> [I] rely on places that are very good at researching what is in the community or in the business world. The [name of lab] is wonderful. Before they implement something they check the computer industry, all these different industries before they make a decision. So I rely—I've got a relationship with them that I enjoy. And I call them and ask, "Have you heard of anything like this?"[9]

Unsurprisingly, the interviews suggested that there is a large asymmetry in the flow of knowledge based on the presence or absence of local resources. That is, the asymmetry is clearly driven in large part by asymmetries in size. We should note, however, that we did find that there were individuals in smaller labs who had system-wide reputations, and who were clearly important hubs in the broader network of knowledge sharing. The DNA crime laboratories across the United States constitute a very heterogeneous population, and that greatly affects the knowledge searching of individuals. Labs range in size across orders of magnitude—from many labs with just a handful of examiners to a handful of labs with hundreds of examiners. We observed that within large labs, knowledge searching typically stays within the labs. However, large labs, by virtue of their sheer volume of experience, often become critical reservoirs of knowledge *for the system*, where individuals from small labs often talk to people in large labs to tap into their experiences, as one interviewee describes:

> I find that when you're a small laboratory and you don't have the time, money and personnel to put in to starting new programs, you're better off to sit back and listen to what everybody else has done, rather than reinvent the wheel. So that's kind of my philosophy on it. That's kind of how I go about getting information. If somebody has already validated a method or

> they're using a particular type of procedure and they say, "Hey, this is the thing to go to," I would defer to their judgment.

We also found some degree of hierarchy within the network, where large states often had a single lab that was much larger than other labs, which then served as the informational hub for the smaller labs in the state, as one participant highlights as being the case in his state: "The one resource that we've definitely leaned on a lot more than the others is the [name of biggest lab in state] lab. Based on our experience, they're the cream of the crop basically."[10]

Although reciprocity is often cited as being one of the building blocks of networks (Coleman, 1988; Gouldner, 1960), these large asymmetries in knowledge sharing limit the role that reciprocity in kind can play in sustaining this knowledge sharing network. More generally, *reciprocity cannot play a major role in sustaining a knowledge-sharing network if knowledge is very unevenly distributed*. That is, the uninformed have little information to offer the knowledgeable, and yet the most important transactions from the systemic perspective in such a scenario are for the knowledgeable to help the unknowledgeable. Elsewhere we explore with these data what drives voluntary engagement in knowledge sharing (Mergel et al., 2008). Why, for example, do individuals from the labs with large reservoirs of knowledge even create ties outside of their organizational boundaries (and, in particular, why with labs with far less resources)? Part of the answer clearly lies in the institutionalized extra network processes that facilitate the creation of ties (Feld, 1981), which we discuss below.

Mechanisms Facilitating Cross-Organizational Ties

There are system-wide processes that facilitate the creation of interorganizational interpersonal ties. Several mechanisms are in place that allow for knowledge exchange across labs. One such mechanism is that of lab audits, or inspections. The inspection process represents an important control function for the FBI. The FBI mandates adherence to particular practices if a laboratory is to remain connected to the NDIS. The inspectors typically include examiners from other labs. The inspections thus have a standard hierarchical function, but with a twist. That is, the FBI has authority within the network, not because they have formal authority over local DNA labs, but because they have authority over the infrastructure that labs need access to. Here, our focus is on the impact that the inspection process has on knowledge sharing, which is considerable. Inspections require a fairly substantial engagement with the practices of another lab, and thus allow for the spread of a large amount of tacit knowledge. One individual describes the process:

> We draw upon other agencies: Their policies and procedures, and also just general experience and knowledge of the individual examiners. That includes the FBI. That includes the neighboring states. It is very common for us to go out and do an audit of another laboratory and bring some of that knowledge that we have gained in the audit home with us.

Inspectors are thus a key conduit of information among labs—both among the labs that they inspect as well as back to their home lab.

Conferences played a particularly important role in facilitating the creation of ties. Participants repeatedly referred to three key conferences. Two of the conferences are annual conferences aimed specifically at forensic scientists: The annual meeting of the American Academy of Forensic Scientists (AAFS), and a conference organized by a large vendor (Promega). In addition, the FBI holds a conference/training aimed specifically at CODIS administrators, allowing them to make contacts with CODIS administrators from other states. Notably, the FBI provides resources to state and local labs to attend (again, there is an interweaving of an element of hierarchy in the

network). The participants in this study repeatedly referred to the role these conferences played in facilitating meeting people from other labs. This intersection of individuals and organizations repeats itself over the years, building deeper relationships. The development of deep relationships, in turn, should facilitate instrumental use of those relationships for knowledge exchange, especially for complex, tacit knowledge (Hansen, 1999).

The Importance of Preexisting Personal Relationships

The social network literature has shown without fail that *prior relationships* are an important determinant for choosing a source of advice (e.g., Granovetter, 1973; Krackhardt & Hanson, 1993; Nelson et al., 2001), which is corroborated by our data. In particular, we observed that individuals first turn to their friends when looking for advice, as one participant describes:

> I'd start with people I know fairly well. And [people] I know that [I have] seen a lot. And I would call someone [from] our surrounding states, because I'm friends with some [people from] our surrounding states. So I'll start with my friends first.

Another participant highlights both the nurturing of relationships through conferences as well as the subsequent instrumental value of those ties:

> You not only get that information during the day, but I think the most important aspect of the meetings is what happens in the evenings. Those bonds you develop as friends allow you to develop those contacts over the years. And that has been an instrumental tool for me in my job. And I think it makes me twice as good as I would be otherwise. I mean my abilities are enhanced tremendously by my contacts.

This finding highlights the intrinsically *interpersonal* nature of interorganizational knowledge sharing. It is clear that *within* organizations, there are often defined channels for resolving ambiguity. However, with a few important exceptions, knowledge sharing *between* organizations within this system relied on personal relationships particular individuals had developed over years. One of the key exceptions involved information about the rules surrounding CODIS, regarding for example, what was allowed into the database. Here many individuals reported going directly to the FBI, after following internal channels, as this participant states:

> I'd call the FBI [about CODIS rules]. [. . .] But I wouldn't mess with anybody besides those people as far as from my perspective. Now we have somebody who's in charge of that in our laboratory, so if there's a general question, I'd probably go to our CODIS administrator first, ask them before we'd go to the CODIS people themselves. And that's how we generally handle that. I wouldn't necessarily go to another laboratory because those standards are open to interpretation and I figure, why mess with other peoples' interpretation, when the FBI's the one really making the ground rules. So I'll just go straight to them.

As can be seen from these quotes, individuals draw on relationships of varying intensity. The oft-hypothesized trade-off between strong and weak ties is between the greater flow of information from strong ties and the higher redundancy of information that comes from strong ties (e.g., Burt, 1992; Granovetter, 1973). The argument is that while strong ties are higher bandwidth, they often provide redundant information because an individual's strong ties tend to know one another and thus have overlapping information. Consider this account of a local network characterized by strong ties:

> [W]ithin our community, we have a private laboratory, just up the street, a big one [name]. We use them a lot for technical knowledge. They are brilliant people up there. [. . .] It's because we've faced the same challenges, basically. And [. . .] sometimes they ask us, "How would you do this sample? Could we look at your protocol for this particular type of sample?" And we'll say, "Absolutely. Come up. We'll show you how we do it." And the reason being that they are truly intertwined in the same battle we are, trying to get DNA from crime scene samples. Trying to get DNA profiles published that meet the quality assurance criteria. So we sometimes interact with them, and sometimes we interact with the neighboring states. It's easiest to call [neighboring state A], because they're our close neighbor. It's easiest to call [neighboring state B], because they're a close neighbor. Not very often that I would call [a faraway state] and ask them a question.

This local orientation in tie formation can lead to a network of strong, but redundant, ties. Our data do not speak directly to whether that is what the network looks like, but it should be a natural consequence of this orientation, and can potentially constitute a barrier to the spread of knowledge.

Obstacles to Information Sharing: Reputational Concerns

Our interviews revealed a number of significant obstacles to seeking information through the network. One major concern was that a question revealed information about the individual asking the question: Ignorance.

In fact, we observed that concerns regarding reputation of being knowledgeable constitute a major obstacle to the interpersonal sharing of information. Individuals generally were concerned about their reputation among their peers, as one individual states: "Sometimes it's difficult because you don't necessarily always like to admit what you don't know." Therefore, before she turns to any other human for advice, this forensic scientist puts great time and effort into ensuring that her question is indeed a legitimate one (as defined by community norms). Furthermore, the fear of revealing their ignorance on an issue often prevents individuals from reaching out to a larger group of people, as is the case when a question is posed on a listserver, and pushes them to seek out informants with whom they have a relationship of trust (e.g., friends). The following account illustrates these concerns:

> There is a professor in statistics that I've taken a couple a classes for training. [. . .] I know him well enough that I have called him on an occasion or two to access his area of expertise . . . [So] if it's a problem I knew for sure we couldn't handle here, I go directly to the statistician I mentioned. If it was one that I believe we handled correctly and I'm looking for confirmation, I'm likely to contact all or some of those folks on [the listserver].

We would attribute this phenomenon in part to the still prevailing culture in public agencies, where the motivational emphasis lies on mistake avoidance rather than increased productivity (Schofield, 2001), and peer pressure strongly affects performance (Wilson, 1991).

A second element was the concern about ramifications outside of the network. Recall that all of this is taking place within an adversarial criminal justice system. Reputation can take the form of being discredited on the stand as an expert. The evolution of the use of listservers offers a particularly interesting case study of the role of the reputation outside of the network. As one participant recounted, a popular list regarding forensics expanded to include an increasing fraction of the outside community: "So the interesting thing is that the listserver evolved, and it evolved to include people who are non-forensic people. There were people on that list that were looking to overturn their convictions." The inclusion of other people on the list—notably defense attorneys—created a concern that what was said on the list might come back and haunt individuals later. This provided the impetus

to create another list that was invitation only: "I felt like we needed a closed group because I wanted to discuss issues candidly and without intrusion or the feeling that you were being spied on by all of these attorneys . . . [W]e wanted a closed group, where we weren't going to have to eat our words on the witness stand, or eat somebody else's words or opinion." Even with the closed nature of a list like this, some members of the community are unwilling to share answers on a listserver:

> I don't respond usually to questions posted to the [list] servers . . . I will respond to individual questions but I generally do not respond to the listserver questions, because I also don't know who's reading them. . . . It's not that I can't [respond], but I don't want if I'm going to court, I'm an expert in court a lot of times, something I say in the listserver to hit me in the face in court.

Listservers offer a particularly public forum for posing (and answering) questions. They are thus particularly powerful means with which to disseminate experiential knowledge. However, that very public character exacerbates concerns about revealing ignorance, which, especially in the context of the criminal justice system, could be devastating. A notable implication is that the presence of barriers can actually facilitate the sharing of knowledge, because they can limit the potential reputational downside of posing questions (similar arguments have been made vis-a-vis deliberation—see Elster, 1999).

Obstacles to Information Sharing: Perceptions of Local Exceptionalism

As noted above, a general condition in this particular policy domain is that actors perceive that much of the relevant knowledge is truly universal. However, we did observe in some cases strong perceptions of local exceptionalism. In particular, we found that the convergence to different standards in different parts of the network created obstacles to communication, as this one individual (from a small lab in a large state) makes clear:

> I don't think I ever have [gone outside of the state system]. [. . .] Going outside the system is a little bit problematic in that things are done differently in different places. We use random match probability, other places are using likelihood ratio or probability of exclusion or something, so, you'd have to consult with somebody using the same stat and interpreting in similar fashion.

That is, different parts of the national network have converged on different ways of expressing the statistical findings. This convergence on different means of expressing statistical certainty makes it difficult to share information beyond state boundaries in this case.

This observation hints at the fact that a classical bureaucratic mindset is at play here. Robert Merton (1957) referred to the "bureaucratic personality" to describe individuals who operate in large, complex organizations and are more interested in following the rules than in achieving the ultimate goal of their organization, thus focusing on the means rather than the ends. To the extent that such attitudes might prevent the sharing of useful information, they will result in an unnecessary reinvention of the wheel at the local level, reducing the collective effectiveness of DNA labs.

Conclusion

This study focused on where individuals who work in DNA labs look for answers to questions that arise on the job, and what determines where these people look under particular circumstances. Our study reveals a constant search for knowledge that transcends organizational boundaries,

where those cross boundary ties are essential for the effectiveness of individuals and organizations in this domain. There is an enduring, evolving network of informal knowledge sharing across DNA laboratories. This article thus illuminates more generally the potential importance of networks of practice in the public sector.

We found that people tend to go through formal structure first, then turn to existing informal networks. Although the tendency for individuals to reach out to others whom they trust, respect, or are friends with, rather than just the one(s) prescribed by an organization's reporting structure to answer a given question, is well established in the organizational literature, the important role that these informal ties play in the public sector is not. In the domain we studied, it is clear that the interpersonal sharing of experience was critical to the functioning of individual laboratories, especially to the small laboratories that did not have the scale to encompass all of the knowledge necessary for the vast variety and complexity of issues that they might encounter. Large labs were particularly important to be knowledge reservoirs, however, we did find that there were individuals in smaller labs who had system-wide reputations, and who were clearly important information hubs in the broader network of knowledge sharing.

These results, above all, highlight the interpersonal dimension of knowledge-sharing processes. Knowledge sharing in this community is clearly embedded within a set of personal relationships that naturally developed over many years. In particular, trust in the knowledge sources played a significant role, confirming the tenet in the social network literature that interpersonal networks are based on trust (Podolny & Page, 1998; Provan & Kenis, 2008; Uzzi, 1997). Trust is a particularly important determinant of whom you go to with questions, because asking questions inherently reveals a vulnerability (Lee, 1997). This potential vulnerability—particularly acute in this generally adversarial domain—also limits the potential of modern communication technologies, such as listservers, in facilitating the matching of questions to people with good answers.

Furthermore, the asking and answering of questions did not reflect an instrumental, quid pro quo exchange of information for information. Indeed, knowledge sharing built on such narrow exchange would have limited potential in this community, because of the uneven distribution of experience. Instead, knowledge sharing was encompassed by the natural, broader exchanges that occur between two people with friendly relationships, where the currency facilitating knowledge exchange may just be as much beer as in kind exchanges. This knowledge exchange was also facilitated, as we discuss elsewhere (Mergel et al., 2008), through a shared language and mission.

Although at the microlevel, these interpersonal factors play a key role in knowledge exchange, at the macrolevel we find that the informal network has a complementary relationship with the formal structures in the system. For example, states need to cooperate on solving particular crimes that cross borders, and sometimes that cooperation yields knowledge sharing as a byproduct. The FBI has a need to oversee the technical infrastructure for data sharing, supporting an annual conference at which every state has at least one representative. These meetings serve not only the FBI's need for control of the system, but also support the emergence of informal relationships among administrators.

Strikingly, and unexpected in our initial framework, we also find that the network of practice takes on some of the functional characteristics of a formal hierarchy. Members of the network have a concern about managing boundaries of the network, because of a concern regarding the security of the information exchanged. There is an emergent pecking order, built not on authority but experience and expertise; and there are silos within the system based on perceptions of local exceptionalism.

There are, of course, limitations to our findings. As noted above, we chose an "easy case" in which to explore networks of practice. This was a domain where there were especially strong functional needs for knowledge sharing, and whose area overlapped with the profession of forensic science. It is an empirical question what the boundary conditions for our findings are. Although there are few areas that are as dynamic as this specific one has been in the last decade, policy

areas from public health to the environment are all rapidly evolving, with substantial potential for innovation at the local level. How does the perception of policy dynamism affect the drive to create relationships? How important are systemic subsidies (e.g., from the FBI to attend the annual CODIS conference) in facilitating tie formation? Would we expect knowledge to be exchanged in a set of individuals who had equally compelling reasons to share their experiences but who did not have repeated opportunities to cultivate personal relationships over the years? Our hope is that this article will spur an examination of other knowledge-sharing networks among public organizations to develop an understanding of the system-level facilitators/inhibitors of networks of practice. It would be useful, for example, to develop a longitudinal study across different policy domains on the role of informal networks in knowledge exchange. How do these domains differ? How do they change over time based on system-level interventions?

Our findings hold important theoretical and practical implications. Theoretically, we have (re-) conceptualized the system of innovation in a federal system to be in part driven by informal relationships among public managers. We also show how learning occurs in a highly controlled system, which differs notably from previous research conducted on learning networks in the private sector (e.g., Powell et al., 1996), where it is generally accepted that knowledge *should* flow through the system. We provided evidence that innovative knowledge is introduced into the system not only as a planned top-down process—as would be expected in a formal hierarchical and bureaucratic organization. Instead, knowledge flows through the lateral and horizontal network of practice ties—outside the prescribed reporting structures. Knowledge that is not available locally can transcend organizational boundaries as a result of individual search strategies, even though the existing configuration of knowledge sharing is designed to prevent this free flow of information within the bureaucratic system.

Moreover, our focus on individual strategies for knowledge sharing provides a different perspective on the literature on knowledge diffusion. We are thus adding an active component to Rogers' (1995) diffusion theory: Knowledge is not passively transported top-down through the social system, but actively sought for bottom-up, based on individual choices. Our data has shown that knowledge permeates the given formal structure and individuals in crime labs actively search for and find knowledge through their informal professional network ties. Moreover, the diffusion process also creates a positive feedback loop that serves as an ad-hoc confirmatory element of knowledge needed to solve a case. As Nonaka (1994) points out, knowledge needs to be socialized within the social system before it is accepted into the local knowledge base and integrated into standard operating procedures.

Our research also contributes to the literature on creativity as a driver for innovation (e.g., Amabile, 1988; Hargadon & Bechky, 2006; West, 2002; Woodman et al., 1993), which has mostly focused on corporate (and often entrepreneurial) settings. We show that creative problem solving is common in a highly controlled bureaucratic environment, possibly even fostered by existing resource constraints. Whereas the emphasis in the corporate creativity literature is placed on creating an organizational culture that encourages creativity, hence innovation, and ultimately a firm's competitive advantage, our focus on individual problem solving strategies reveals how creative solutions bubble up in the system, driven by a different set of environmental factors (such as rapidly evolving technology and the exponentially expanding use of DNA evidence in court), and the need to make do with what is available.

These findings also highlight some of the mechanisms of isomorphism in decentralized systems (DiMaggio & Powell, 1983). Thus, for example, despite the system of dual sovereignty in the United States, the federal government uses its power over the infrastructure to enforce implementation of certain practices in DNA laboratories. The necessity to communicate and coordinate with neighboring states, one would guess, has likely led to local convergence in practice. The support

by the FBI for an annual conference has clearly fueled the emergence of system-wide networks as well as mimetic processes that should yield a substantial degree of system-wide convergence in practices that are not directly regulated by the FBI.

Finally, the findings of our study suggest certain practical recommendations. Specifically, knowledge sharing is the direct result of personal relationships. Those personal relationships, in turn, are partly the result of investments by governments (state, local, and federal) in events that repeatedly convene individuals together over the years. These investments are not just in human capital (helping individuals learn more) but also in social capital (relationships that facilitate knowledge exchange). If one conceives of the capacity of an agency as in part being in the personal relationships that its members have, then this yields a set of subsidiary questions about investments by an agency: Does the agency send its staff to enough external events? Should it focus its investments in social capital on just a few (who then have the opportunity to build those relationships) or more individuals? Which staff members offer capacity through their external networks?

This construction also offers a distinctive role for those with an eye on the functioning of the system (e.g., the federal government). This is particularly important, because the "network" is truly a public good, and there is no reason to believe that the concatenation of agency choices to invest/not invest in their own social capital would yield desirable outcomes from the systemic point of view. Indeed, there is reason to believe that there may be multiple equilibria, some of which are quite undesirable. For example, it is conceivable that in certain domains there are no collective mechanisms for facilitating knowledge sharing, because no single agency has the capacity to create such a forum (e.g., a national conference). Furthermore, even in this domain, it is clear that there is a certain degree of parochialism that in other domains might preclude the realization by agencies of the potential to learn from others. The domain we examined had a federal sponsor that had to create and subsidize attendance at such a forum (the annual CODIS conference) for purposes of control over the national DNA database. This, we would guess, is the exception rather than the rule. It is not clear that, the need for control being absent, such investments would have been made. Our findings hint at an important federal role to foster these interorganizational/interpersonal networks to leverage the often latent knowledge/expertise/innovations that occur within the decentralized governance system of the United States. In short, to take advantage of the "laboratories of democracy," as Brandeis pithily described it, it is necessary to proactively connect those laboratories.

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Notes

1. Knowledge is different from information in that knowledge requires interpretation to be acquired, which generally occurs through a learning process (Nonaka, 1994).
2. Two prominent examples for communities of practice in the literature are the apprenticeship system of Yucatec midwives (Lave & Wenger, 1991), and the sharing of knowledge among spatially dispersed Xerox repair representatives (Brown & Duguid, 1991).
3. The field of forensic science is defined by the American Association of Forensic Scientists as "the application of the natural sciences to matters of the law."
4. An example found on the website of the Maine state crime lab illustrates the goal of CODIS: "In 1992 five women were bound, gagged, and stabbed in a reported drug house in Oklahoma City. Based on evidence at the crime scene, the Oklahoma State Bureau of Investigation developed a DNA profile for the killer in 1995. The California DoJ used CODIS to match the evidence profile against Danny Keith Hooks, who was convicted of rape, kidnapping, and assault in California in 1998." (http://www.maine.gov/dps/msp/criminal_investigation/crimelab/codis.htm).
5. There may be profiles that are allowed by state rules that are not allowed by federal rules. Such profiles would be accessible only within SDIS and not NDIS.
6. Both directors of DNA units as well as directors of entire crime labs were included in the "lab director" category: Generally, a crime lab has several divisions, of which only one conducts DNA analysis. Other common divisions (or units) are toxicology, serology, ballistics, and fingerprinting.
7. The percentage indicates the level of agreement between all coders; that is, 85% of all individually identified codes overlapped.
8. The utilization of databases involves statistical analyses of the data. A difficult question that comes up frequently, for example, is how to evaluate the probability that someone in the database might be one of the sources of biological material within a mixture of samples collected from a crime scene.
9. Of course, the lab is composed by several individuals, and the respondent was referring to his peers, that is, the DNA forensic scientists within that specific lab.
10. However, as a countervailing force to this big–small pattern, we observed that individuals frequently reach out to labs of similar size across states.

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